Solitons mobility in a dipolar Bose-Einstein condensate in an optical lattice

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Abstract

The present work is devoted to the theoretical investigation of the dynamics of Bose –Einstein condensates (BEC) in optical lattice with the long range magnetic dipole-dipole interaction between atoms. The system is described by a nonlocal nonlinear Schrodinger equation (NLSE). We consider the case when the lattice depth is sufficiently large (tight binding approximation). In this case nonlocal NLSE can be reduced to discrete NLSE equation. We show that discrete NLSE equation for some range of parameters can be reduced further to integrable Ablowitz-Ladik equation which supports moving solitons. Taking the one-soliton solution of Ablowitz-Ladik equation as an initial condition we have performed detailed numerical study of a soliton dynamics in both nonlocal NLSE and discrete NLSE. The conditions of existence and stability of moving solitons in dipolar BEC in an optical lattice are numerically revealed. Also the applicability limits for the tight binding approximation for the experimentally achievable range of parameters are investigated.

Keywords: Bose-Einstein condensate, solitons, dipolar interaction